

FORM PTO-1390 (Modified) (REV 11-2000)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER <b>217211US0PCT</b>	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR <b>357926737</b> )	
INTERNATIONAL APPLICATION NO. <b>PCT/JP00/03800</b>		INTERNATIONAL FILING DATE <b>12 June 2000</b>		PRIORITY DATE CLAIMED <b>11 June 1999</b>	
TITLE OF INVENTION <b>OPTICAL SHEET</b>					
APPLICANT(S) FOR DO/EO/US <b>Toshiyuki ITO, et al.</b>					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
<ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.</li> <li>4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371 (c) (2)) <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau).</li> <li>b. <input checked="" type="checkbox"/> has been communicated by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</li> </ol> </li> <li>6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)). <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> is attached hereto.</li> <li>b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).</li> </ol> </li> <li>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3)) <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).</li> <li>b. <input type="checkbox"/> have been communicated by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made, however, the time limit for making such amendments has NOT expired.</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).</li> <li>10. <input type="checkbox"/> An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).</li> <li>11. <input type="checkbox"/> A copy of the International Preliminary Examination Report (PCT/IPEA/409).</li> <li>12. <input checked="" type="checkbox"/> A copy of the International Search Report (PCT/ISA/210).</li> </ol> <p>Items 13 to 20 below concern document(s) or information included:</p> <ol style="list-style-type: none"> <li>13. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</li> <li>14. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</li> <li>15. <input type="checkbox"/> A <b>FIRST</b> preliminary amendment.</li> <li>16. <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.</li> <li>17. <input type="checkbox"/> A substitute specification.</li> <li>18. <input type="checkbox"/> A change of power of attorney and/or address letter.</li> <li>19. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.</li> <li>20. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</li> <li>21. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</li> <li>22. <input type="checkbox"/> Certificate of Mailing by Express Mail</li> <li>23. <input checked="" type="checkbox"/> Other items or information:</li> </ol> <p><b>PC/IB/304</b> <b>PCT/IB/308</b> <b>Notice of Priority</b> <b>Form PTO 1449</b></p>					

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

09/926737

INTERNATIONAL APPLICATION NO.

PCT/JP00/03800

ATTORNEY'S DOCKET NUMBER

217211US0PCT

24. The following fees are submitted:

**BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :**

- ☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO ..... \$1040.00
- ☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO ..... \$890.00
- ☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$740.00
- ☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) ..... \$710.00
- ☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) ..... \$100.00

**ENTER APPROPRIATE BASIC FEE AMOUNT =**

\$890.00

Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)).

☐ 20 ☐ 30

\$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	- 20 =	0	x \$18.00	\$0.00
Independent claims	- 3 =	0	x \$84.00	\$0.00

Multiple Dependent Claims (check if applicable) ☐

\$0.00

**TOTAL OF ABOVE CALCULATIONS =**

\$890.00

☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.

\$0.00

**SUBTOTAL =**

\$890.00

Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)).

☐ 20 ☒ 30 +

\$130.00

**TOTAL NATIONAL FEE =**

\$1,020.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).

☐

\$0.00

**TOTAL FEES ENCLOSED =**

\$1,020.00

Amount to be:  
refunded \$  
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- a. ☒ A check in the amount of **\$1,020.00** to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \_\_\_\_\_ to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **15-0030**. A duplicate copy of this sheet is enclosed.
- d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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REGISTRATION NUMBER

DATE **Dec. 11 2001**

## Specification

Optical sheet

## Field of the invention

The present invention relates to an optical sheet having very fine surface irregularities such as a Fresnel lens sheet or a lenticular lens sheet to be used for a screen of a projection TV or a projector, or a condensing Fresnel lens sheet or an emboss sheet.

## Background art

When a large size lens sheet such as Fresnel lens sheet, lenticular lens sheet, etc. is produced, it has been generally practiced to use a press method. According to this method, a planar lenticular mold having irregular surface pattern to match the irregular surface pattern of the desired lens surface is heated, and by pressing this lenticular mold onto a resin plate, irregular surface pattern on the surface of the lenticular mold is transferred to the resin plate. However, this press method has such problems that molding cycle is long and productivity is not very high. In this respect, a photo-polymer method (2P method) has been recently developed. According to this method, UV-setting resin is coated on a lenticular mold, and a resin plate is placed on it. Then, ultraviolet ray is irradiated to harden the UV-setting resin, and a large size lens sheet is formed. However, the productivity is

not sufficiently improved by the use of this 2P method.

On the other hand, another method is introduced, in which a metal mold having irregular surface pattern to match the irregular surface pattern of the desired lens is used, and a relatively small size optical sheet is molded by an injection molding method. In the injection molding method, molten resin is injected and filled in a cavity of the metal mold, and pressure is applied in the cavity via the molten resin in spool or runner until gate is cooled down and solidified (dwell pressure application process), and the pattern of the metal mold is transferred to the resin. After the gate is solidified, the resin in the metal mold is cooled down and solidified, and a molded product (optical sheet) is obtained.

The molten resin injected and filled in the cavity by the injection molding method is quickly cooled down when it is brought into contact with the surface of the cavity. A cooled and solidified layer is formed, and the molten resin is filled in the cavity. When the cooled and solidified layer is formed, pressure distribution occurs in the cavity as the molten resin is filled. This exerts action as residual stress of the molded product and causes warping, deformation, etc. after molding. Dwell pressure is applied to compensate shrinkage of the molded product after injection molding, and this also causes residual stress in the molded product.

If there is residual stress remaining in the molded product, warping, waviness, etc. are very likely to occur on the molded product when it is left under environmental condition of high

temperature and high humidity for long time. The larger and the thinner the molded product is, the higher the extent of warping and waviness is in the molded product.

To suppress the formation of the cooled and solidified layer, which causes the development of residual stress, attempts are made to increase temperature of the molten resin, to raise temperature of the metal mold, or to increase filling rate. In the past, however, there has been no attempt to study the standard value of residual stress remaining in the optical sheet after molding. Thus, each time the optical sheet is formed by changing the molding condition, it is necessary to determine whether the molding condition is adequate or not by performing long-term reliability test.

To solve the above problems, it is an object of the present invention to provide an optical sheet, which has lower residual stress and is free from warping, deformation, etc.

#### Disclosure of the invention

To attain the above object, the optical sheet according to the present invention is an optical sheet produced by injection molding method and having stress of up to  $200 \text{ kg/cm}^2$  on surfaces of two opposing main planes. In this optical sheet, each of stresses on the surfaces of the two opposing main planes is preferably up to  $200 \text{ kg/cm}^2$ , and difference of stress on the two main planes is preferably within 20%. Here, "main planes" means two opposing

planes having large area and corresponding to exit surface of the light and to rear surface of the optical sheet. For instance, this optical sheet has an area or 4000 cm<sup>2</sup> or more and thickness of 4 mm or less.

The stress as described above is calculated as follows: A test piece of about 0.6 mm in width and having a mirror surface is prepared from the optical sheet. On the test piece thus obtained, retardation R of strain is determined under multiplication factor of x 5 using a Babinet compensator type precision strain gauge with Na light source. The stress is calculated by the following equation:

$$\text{Strain (stress)} = R / (E \times T)$$

where R is retardation, and T represents thickness (cm) of the test piece where retardation is measured, and E is a photoelastic constant [(nm/cm)  $\times$  / (kg/cm<sup>2</sup>)] of the material of the optical sheet.

#### Brief description of the drawings

Fig. 1 is a drawing to show a shape of a molded product produced using a metal mold No. 1 in an embodiment of the present invention;

Fig. 2 is a drawing to show a shape of a molded product produced using a metal mold No. 2 in an embodiment of the present invention;

Fig. 3 is a drawing to show a shape of a molded product produced using a metal mold No. 3 in an embodiment of the present invention;

Fig. 4 is a drawing to show a shape of a molded product produced using a metal mold No. 4 in an embodiment of the present invention;

Fig. 5 is a drawing to show a shape of a molded product produced using a metal mold No. 5 in an embodiment of the present invention;

Fig. 6 is a drawing to explain a measuring position and a measuring method of a deformation amount of an optical sheet. Fig. 6 (a) represents a measuring position, and Fig. 6 (b) shows a measuring method; and

Fig. 7 shows specification of each of the metal molds used in the Examples and the Comparative examples.

#### Best mode for carrying out the invention

When an optical sheet is produced by an injection molding method, one of the following methods is used to limit stress on the surface of the optical sheet up to  $200 \text{ kg/cm}^2$ : An ordinary injection method, an injection molding method under low pressure molding by reducing filling pressure, or an injection compression molding method. After the optical sheet is prepared by one of these methods, annealing (post-processing) should be performed so that the stress on the surface will be up to  $200 \text{ kg/cm}^2$ . Specifically, the optical sheet prepared by the injection compression molding method is sandwiched between glass plates. Then, annealing is performed for 2 - 4 hours at an environmental temperature, which is by  $10^\circ\text{C}$  to  $20^\circ\text{C}$  lower than deflection temperature under load (to be determined by the method such as ASTM D648) of a molding material, which constitutes the optical sheet.

Also, when the injection molding method (proposed in JP-





resin. For instance, polymethyl methacrylate, polycarbonate, polystyrene, thermoplastic elastomer, non-crystalline polyolefin, polyamide, or copolymer of these substances may be used.

Detailed description will be given below on the present invention referring to the examples. The equipment and the devices used for the manufacture of the optical sheet in the examples are as follows:

(a) Injection molding machine

An injection molding machine "SG-150SYCAP M III" (trade name; product by Sumitomo Heavy Industries, Ltd.), or "MDIP-1400" (trade name; product by Meiki Co., Ltd.) was used.

(b) Metal mold

Five types of metal molds were used. The size of each of the metal molds was as follows:

(Metal mold No. 1)

This has a cavity of planar shape in size of  $200 \times 220 \times 4.0$  mm (length  $\times$  width  $\times$  thickness). On one of the main planes, a Fresnel lens pattern of 10 to 80  $\mu$ m in height is formed. As shown in Fig. 1, a gate of 25 mm in width and 3.5 mm in thickness is provided at the center of lateral side of the metal mold. Gate of the lens sheet (optical sheet) is cut using heat nipper or saw blade. The configuration of the metal mold No. 1 is as shown in Fig. 7 (a). Thin plate members 5 are mounted on a movable side 3 and a fixed side 4, and the Fresnel lens pattern is formed on one of the thin plate members 5. When necessary, the member with low thermal

conductivity is attached on rear surface of the thin plate member.  
(Metal mold No. 2)

This has a cavity of planar shape in size of  $400 \times 800 \times 4.0$  mm (length  $\times$  width  $\times$  thickness). On one of the main planes, a Fresnel lens pattern of 10 to 80  $\mu$ m in height is formed. As shown in Fig. 2, a gate in size of 25 mm in width and 3.5 mm in thickness is provided at the center of lateral side of the metal mold. The configuration of the metal mold No. 2 is as shown in Fig. 7 (b). Thin plate members 5 are mounted on a moving side 3 and a fixed side 4 respectively, and the Fresnel lens pattern is formed on one of the thin plate members 5. When necessary, the member with low thermal conductivity is attached on rear surface of the thin plate member. The metal molds No. 3 to No. 5 have the same arrangement as the metal mold No. 2.

(Metal mold No. 3)

This has a cavity of planar shape in size of  $500 \times 900 \times 2.0$  mm (length  $\times$  width  $\times$  thickness). On one of the main planes, a Fresnel lens pattern of 10 to 80  $\mu$ m in height is formed. As shown in Fig. 3, a gate of 25 mm in width and 1.5 mm in thickness is provided at the center of lateral side of the metal mold.

(Metal mold No. 4)

This has a cavity of planar shape in size of  $700 \times 900 \times 2.0$  mm (length  $\times$  width  $\times$  thickness). On one of the main planes, a Fresnel lens pattern of 10 to 80  $\mu$ m in height is formed. On the

other surface, a prism pattern of 10  $\mu\text{m}$  in height is formed. As shown in Fig. 4, a gate of 500 mm in width and 1.5 mm in thickness is provided at the center of lateral side of this metal mold. (Metal mold No. 5)

This has a cavity of planar shape in size of  $800 \times 1000 \times 2.0$  mm (length  $\times$  width  $\times$  thickness). On one of main planes, a Fresnel lens pattern of 10 to 80  $\mu\text{m}$  in height is formed. On the other surface, a prism pattern of 10  $\mu\text{m}$  in height is formed. As shown in Fig. 5, a gate of 500 mm in width and 1.5 mm in thickness is provided at the center of lateral side of this metal mold.

(c) Molding material

A methacrylic resin molding material "Parapet GH-1000S" (trade name; product by Kuraray Co., Ltd.) was used.

(d) Method to measure stress on the surface of the molded product

Using a low speed saw "ISOMET" (trade name; product by Buehler), a piece in form of a tablet of about 0.6 mm in width was cut off from the molded product. By polishing both cutting surfaces using No. 2000 sandpaper and metal polishing agent, a test piece having mirror surface was prepared. On each of the test pieces thus obtained, distortion retardation R was determined under the magnification factor of  $\times 5$  using Na light source and a Babinet compensator type precision strain gauge "SVP-30 II" (trade name; product by Toshiba Glass Co., Ltd.). The stress was calculated by the following equation:

$$\text{Strain (stress)} = R / (3.8 \times T)$$

where R is retardation, and T represents thickness (cm) of the test piece at retardation measuring portion. The value 3.8 is a photoelastic constant [(nm/cm) / (kg/cm<sup>2</sup>)] of polymethyl methacrylate.

(e) Method to measure transfer rate

Using a surface roughness measuring instrument Surfcomder "SE-30D" (trade name; product by Kosaka Laboratory Ltd.), the height of the pattern on the molded product was measured, and a ratio of pattern dimension of the molded product to pattern dimension of the metal mold used for the molding (dimension of molded product/dimension of metal mold) was calculated.

(f) Method to measure deformation amount

As shown in Fig. 6 (a) and Fig. 6 (b), the deformation amount of the optical sheet 1 was measured at each of the corners of the molded product. Specifically, the optical sheet 1 was placed on a platen 2, and a gap L between the platen 2 and the optical sheet 1 was measured using a thickness gauge, and a error between the form of the metal mold and the form of the optical sheet was determined.

(g) Constant temperature and humidity test

Reliability test of the optical sheet was performed using a constant temperature and humidity chamber (manufactured by Tabai Co., Ltd.). Testing condition was 50 °C at 80% relative humidity for 300 hours.

Examples 1 to 5 and Comparative examples 1 to 5

Using the injection molding machine described in (a) and the metal molds of (b) above, optical sheets were prepared under the molding condition and the annealing condition shown in Table 1. In each of the Examples and Comparative examples, injecting condition and cooling time were the same. The injecting condition was 100 cc/sec., and the cooling time was 60 sec. On the optical sheets thus obtained, stress on the surface layer where the Fresnel lens pattern was formed was measured by the measuring method of (d) above. Then, each optical sheet was left to stand under environmental condition of 50 °C and 80% relative humidity in the constant temperature and humidity chamber as given in (g) above. The amount of deformation after 300 hours was determined by the measuring method given in (f) above. The results are summarized in Table 2 and Table 3. As shown in Fig. 6, measuring position of the stress and the deformation shown in Tables 2 and 3 were as follows: Measuring positions A - D were at four corners of the lens sheet, and the measuring position E is at the center. (The same applies to Table 5 as given later.)

Table 1

	Molding machine	Resin temperature (°C) and metal mold temperature (°C)	Metal mold (Thin plate member (thickness in mm) /low thermal conductivity member (thickness in mm))	Annealing
Example 1	SG-150	270 80	Nickel (0.5)/None	80 °C for 3 hours. Then, gradually cooled down
Example 2	MDIP-1400	270 80	Nickel (0.5)/polyimide (0.1)	None
Example 3	MDIP-1400	270 80	Nickel (0.5)/polyimide (0.2)	None
Example 4	MDIP-1400	270 80	Nickel (0.5)/polyimide (0.3)	None
Example 5	MDIP-1400	270 80	Nickel (0.5)/polyimide (0.3)	None
Comparative example 1	SG-150	270 80	Nickel (0.5)/None	None
Comparative example 2	MDIP-1400	270 80	Nickel (0.5)/None	None
Comparative example 3	MDIP-1400	270 80	Nickel (0.5)/None	None
Comparative example 4	MDIP-1400	270 80	Nickel (0.5)/None	None
Comparative example 5	MDIP-1400	270 80	Nickel (0.5)/None	None

Table 2

	Metal mold No.	Stress on surface layer (kg/cm <sup>2</sup> )		Pattern transfer rate	Deformation before test (mm)	Deformation after test (mm)
		Measuring position	Stress			
Example 1	1	A	117	0.90	0.02	0.21
		B	104	0.92	0.03	0.17
		C	96	0.91	0.03	0.14
		D	90	0.92	0.02	0.03
		E	100	0.95		
Example 2	2	A	155	0.94	0.02	0.30
		B	150	0.94	0.03	0.32
		C	122	0.93	0.02	0.20
		D	133	0.93	0.03	0.03
		E	145	0.95		
Example 3	3	A	175	0.96	0.04	0.23
		B	160	0.93	0.03	0.15
		C	132	0.97	0.02	0.20
		D	133	0.98	0.03	0.13
		E	145	0.95		
Example 4	4	A	170	0.90	0.05	0.35
		B	165	0.91	0.06	0.28
		C	142	0.95	0.05	0.25
		D	123	0.91	0.03	0.33
		E	145	0.90		
Example 5	5	A	170	0.96	0.07	0.20
		B	166	0.93	0.06	0.25
		C	143	0.92	0.03	0.28
		D	140	0.91	0.05	0.24
		E	155	0.95		

Table 3

	Metal mold No.	Stress on surface layer (kg/cm <sup>2</sup> )		Pattern transfer rate	Deformation before test (mm)	Deformation after test (mm)
		Measuring position	Stress			
Example 1	1	A	225	0.95	0.04	2.54
		B	236	0.93	0.03	3.11
		C	223	0.94	0.04	2.20
		D	246	0.94	0.05	2.50
		E	235	0.93		
Example 2	2	A	255	0.93	0.13	5.35
		B	253	0.93	0.08	4.17
		C	230	0.94	0.10	3.83
		D	216	0.95	0.09	3.44
		E	215	0.92		
Example 3	3	A	265	0.91	0.23	5.30
		B	273	0.91	0.18	6.21
		C	251	0.92	0.13	4.30
		D	239	0.95	0.22	3.20
		E	241	0.97		
Example 4	4	A	325	0.90	0.43	3.35
		B	293	0.93	0.31	4.43
		C	260	0.95	0.21	3.22
		D	251	0.94	0.37	3.21
		E	315	0.90		
Example 5	5	A	288	0.90	0.32	4.23
		B	296	0.93	0.17	5.13
		C	275	0.95	0.19	4.83
		D	287	0.98	0.25	4.20
		E	264	0.97		

As shown in Tables 2 and 3, in the optical sheets of Examples 1 to 5 where stress on the surface layer was 200 kg/cm<sup>2</sup> or less, the deformation amount was low after the constant temperature and humidity test. On the other hand, in the optical sheets of Comparative examples 1 to 5 where stress on the surface layer was more than 200 kg/cm<sup>2</sup>, the deformation amount after the constant temperature and humidity test was higher. On the lens sheets of



Examples 1 to 5, deformation amount was lower in each of the following tests: (1) a test to dry up at 70 °C for 300 hours; (2) a test to leave the sheet at -20 °C for 300 hours; and (3) a test to leave the sheet alternately at low temperature of -20 °C and at high temperature of +70 °C and to repeat this for 100 cycles.

#### Examples 6 to 13

Using the injection molding machine of (a) and the metal molds given in (b) above, optical sheets were prepared under the molding condition and the annealing condition shown in Table 4. In each of these Examples, the injecting condition and the cooling time were the same. The injecting condition was 100 cc/sec., and the cooling time was 60 sec. On the lens sheets thus obtained, stress was determined by the measuring method given in (d) above on the surface layer where the Fresnel lens pattern was formed and the surface where the Fresnel lens pattern was not formed (mirror surface). Then, the deformation amount was measured by the same procedure as in Examples 1 to 5. The results are summarized in Table 5.

Table 4

	Molding machine	Metal mold temperature (°C)		Metal mold (Thin plate member (thickness in mm) /low thermal conductivity member (thickness in mm))	Annealing
		Prism surface side	Fresnel lens side		
Example 6	SG-150	80	80	Nickel (0.5)/None	80 °C for 3 hours
Example 7	MDIP-1400	80	80	Nickel (0.5)/polyimide (0.1)	None
Example 8	MDIP-1400	80	80	Nickel (0.5)/polyimide (0.2)	None
Example 9	MDIP-1400	80	80	Nickel (0.5)/polyimide (0.3)	None
Example 10	MDIP-1400	80	80	Nickel (0.5)/polyimide (0.3)	None
Example 11	SG-150	80	70	Nickel (0.5)/None	80 °C for 2 hours
Example 12	MDIP-1400	60	80	Nickel (0.5)/polyimide (0.1)	None
Example 13	MDIP-1400	60	80	Nickel (0.5)/polyimide (0.2)	None

Table 5

	Metal mold No.	Stress on surface layer (kg/cm <sup>2</sup> )			Pattern transfer rate	Deformation before test (mm)	Deformation after test (mm)
		Measuring position	Stress (prism surface side)	Stress (Fresnel lens side)			
Example 6	1	A	127	138	0.93	0.02	0.25
		B	136	125	0.99	0.03	0.27
		C	108	98	0.93	0.01	0.13
		D	102	105	0.92	0.03	0.15
		E	123	118	0.93		
Example 7	2	A	175	180	0.92	0.03	0.34
		B	150	145	0.90	0.03	0.32
		C	122	113	0.92	0.04	0.27
		D	133	124	0.93	0.06	0.15
		E	127	120	0.96		
Example 8	3	A	185	160	0.93	0.04	0.36
		B	170	155	0.94	0.03	0.25
		C	152	134	0.98	0.03	0.20
		D	140	137	0.95	0.02	0.23
		E	185	163	0.95		
Example 9	4	A	163	180	0.90	0.04	0.41
		B	176	155	0.92	0.05	0.23
		C	142	126	0.94	0.07	0.45
		D	153	175	0.93	0.07	0.25
		E	132	138	0.92		
Example 10	5	A	145	166	0.91	0.04	0.16
		B	175	155	0.92	0.07	0.35
		C	148	133	0.95	0.05	0.37
		D	132	143	0.95	0.08	0.51
		E	180	165	0.94		
Example 11	1	A	120	162	0.93	0.01	2.21
		B	125	163	0.93	0.03	2.12
		C	110	146	0.94	0.03	1.87
		D	100	146	0.95	0.04	2.60
		E	124	138	0.90		
Example 12	2	A	185	145	0.92	0.33	3.45
		B	170	133	0.92	0.25	3.23
		C	150	111	0.94	0.28	2.48
		D	147	100	0.95	0.23	2.51
		E	146	110	0.96		
Example 13	3	A	195	152	0.94	0.35	3.75
		B	174	133	0.95	0.33	4.16
		C	140	105	0.96	0.41	3.48
		D	155	110	0.96	0.32	3.51
		E	148	113	0.90		

As shown in Table 5, in the optical sheets of Examples 6 to 10 where stress on the surface layer was 200 kg/cm<sup>2</sup> or less and difference of stress between front surface and rear surface was within 20%, deformation amount after test was very low. On the other hand, in the optical sheets of Examples 11 to 13 where difference of stress between front surface and rear surface was more than 20% although the stress on the surface layer was 200 kg/cm<sup>2</sup> or less, deformation amount after test was somewhat higher.

#### Industrial applicability

As described above, in the optical sheet complying with the standard value of the residual stress of the surface according to the present invention, neither warping nor deformation occurs after molding. This optical sheet can be used in the applications such as Fresnel lens sheet or lenticular lens sheet to be used for a screen of a projection TV, a projector, etc., and as a condensing Fresnel lens sheet, an emboss sheet, etc.

What is claimed is:

1. An optical sheet produced by injection molding method, wherein stresses on surface layers of two opposing main planes is up to 200 kg/cm<sup>2</sup>.

2. An optical sheet according to claim 1, wherein a difference of stress on surface layers of two opposing main planes is within 20%.

3. An optical sheet according to claim 1 or 2, wherein area of the main plane is 4000 cm<sup>2</sup> or more, and thickness is 4 mm or less.

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Fig. 1

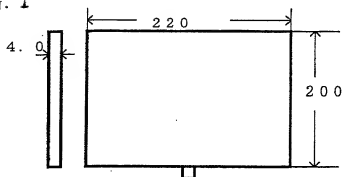


Fig. 2

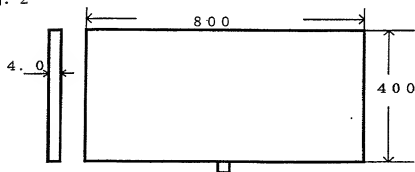
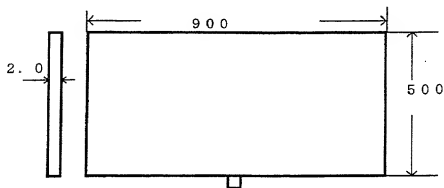


Fig. 3



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Fig. 4

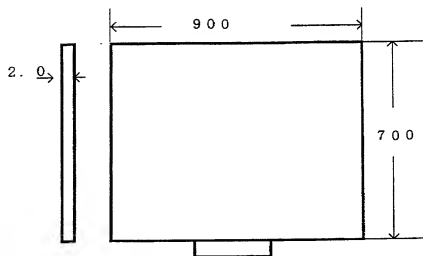
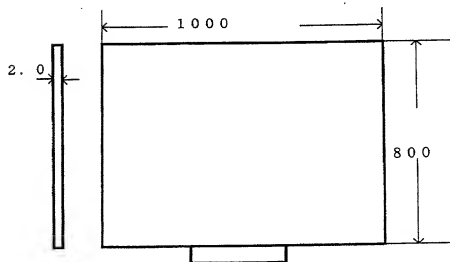


Fig. 5



206160.22792660

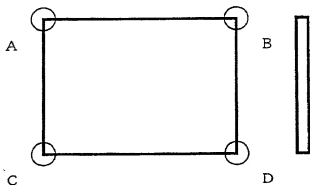
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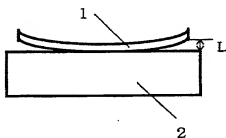
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Fig. 6

(a)



(b)



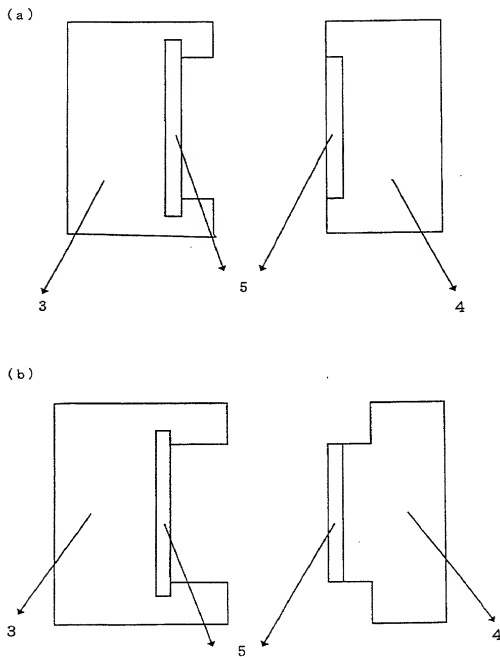


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Fig. 7



200100-22/02660

Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者（下記の名称が複数の場合）であると信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled.

OPTICAL SHEET

上記発明の明細書は、

☐ 本書に添付されています。

the specification of which

☐ is attached hereto.

☒ 月 日に提出され、米国出願番号または特許協定条約国際出願番号を \_\_\_\_\_ とし、  
(該当する場合) \_\_\_\_\_ に訂正されました。

☒ was filed on June 12, 2000  
as United States Application Number or  
PCT International Application Number  
PCT/JP00/03800 and was amended on  
\_\_\_\_\_ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されたとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

# Japanese Language Declaration

(日本語宣言書)

私は、米国法典第35編119条 (a) - (d) 項又は365条 (b) 項に基づき下記の、米国以外の国の少なくとも一か国を指定している特許協力条約365 (a) 項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

Prior Foreign Application(s)

外国での先行出願

11-164976

(Number)  
(番号)

JAPAN

(Country)  
(国名)

(Number)

(番号)

(Country)

(国名)

私は、第35編米国法典119条 (e) 項に基づいて下記の米国外特許出願規定に記載された権利をここに主張いたします。

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

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(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

私は、私自信の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じることに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Priority Claimed

優先権主張

☒ Yes  
はい

☐ No  
いいえ

11/6/99

(Day/Month/Year Filed)  
(出願年月日)

(Day/Month/Year Filed)

(出願年月日)

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Status: Patented, Pending, Abandoned)  
(現況: 特許許可済、係属中、放棄済)

(Status: Patented, Pending, Abandoned)  
(現況: 特許許可済、係属中、放棄済)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

## Japanese Language Declaration

(日本語宣言書)

委任状：私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。

(弁理士、または代理人の指名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: (list name and registration number)

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## Japanese Language Declaration

(日本語宣言書)

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国籍		Citizenship	
郵便の宛先		Post Office Address	

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国籍		Citizenship	
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(第六またはそれ以降の共同発明者に対しても同様な情報および署名を提供すること。)

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